

SEARCH FOR MATERIALS BEYOND THE CAPABILITIES OF NI-BASED SUPERALLOYS: A PARTIAL JOURNEY

Ramgopal Darolia, GE Aviation (Retired), USA
ram.darolia@gmail.com

Higher engine efficiency, reduced specific fuel consumption, improved component durability and reliability, reduced noise and reduced life cycle costs are continually desired in turbines used for propulsion and power generation. Engine components are subjected to very high temperatures, stresses, and oxidizing, corrosive and erosive environments. To meet these demands, materials beyond the capabilities of Ni-base superalloys are being sought. In addition to higher strength, ductility, fracture toughness, impact resistance, reduced density, improved environmental resistance and better coating compatibility are being emphasized. Manufacturability and lower cycle cost are also key requirements. Unfortunately, an acceptable balance in mechanical, physical and environmental properties has been difficult to achieve.

Specific design requirements for production and newer versions of turbines will be outlined. Several design concepts and studies on turbine blades will be presented to emphasize the role of alloy density in not only reducing the weight and stresses in the blades, but also other associated components such as turbine disk. Various material systems under development will be compared and discussed including current development strategies, activities and progress. Challenges and case studies will be presented. The presentation will also present a futuristic vision for new turbine materials.